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Trends in social inequality in physical inactivity among Danish adolescents 1991–2014☆

N.F. Johnsen[a,b,*], M. Toftager[b], O. Melkevik[a,b], B.E. Holstein[b], M. Rasmussen[b]

[a] National Research Centre for the Working Environment, Lersø Parkallé 105, 2100 Copenhagen Ø, Denmark
[b] National Institute of Public Health, University of Southern Denmark, Øster Farimagsgade 5A, 1353 Copenhagen K, Denmark

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ABSTRACT

The aim of this study was to investigate social inequality in physical inactivity among adolescents from 1991 to 2014 and to describe any changes in inequality during this period. The analyses were based on data from the Danish part of the HBSC study, which consists of seven comparable cross-sectional studies of nationally representative samples of 11–15-year old adolescents. The available data consisted of weekly time (hours) spent on vigorous physical activity and parental occupation from 30,974 participants. In summary, 8.0% of the adolescents reported to be physically inactive, i.e. spend zero hours of vigorous leisure time physical activity per week. The proportion of physically inactive adolescents was 5.4% in high social class and 7.8% and 10.8%, respectively, in middle and low social class. The absolute social inequality measured as prevalence difference between low and high social class did not change systematically across the observation period from 1991 to 2014. Compared to high social class, OR (95% CI) for physical inactivity was 1.48 (1.32–1.65) in middle social class and 2.18 (1.92–2.47) in lower social class. This relative social inequality was similar in the seven data collection waves (p = 0.971). Although the gap in physical inactivity between social classes does not seem to be widening in Danish adolescents, there are still considerable differences in the activity levels between high, middle and low social class adolescents. Consequently, there is a need for a targeted physical activity intervention among adolescents from low (and middle) social class.

Introduction

Physical inactivity in children and adolescents has a range of negative effects such as increased risk of overweight (Janssen & LeBlanc, 2010), poor mental health (Biddle & Asare, 2011; Ussher, Owen, Cook, & Whincup, 2007; Kantomaa, Tammelin, Ebelig, & Taanila, 2008), social problems, thought and attention problems (Kantomaa et al. 2008), loneliness (Page & Tucker, 1994) and learning problems at school (Davis et al., 2011; Rasberry, Lee, Robin, Laris, & Russell, 2011). Since physical activity patterns may track from childhood to adulthood (Telema et al., 2005), patterns of physical inactivity during childhood and youth may influence health in adulthood. Insight into physical activity distributions across population groups may therefore contribute to future interventions and policies to minimize physical inactivity among children and young people.

While the current body of evidence includes a large number of studies describing the distribution, determinants and outcomes of various levels of physical activity, we know very little about the relatively small group of individuals who are not physically active at all. Physically inactive adolescents constitute a group at potentially high risk of obesity, diabetes, psychological problems and social marginalization. Investigating the social distribution of physical inactivity and the trends across time is therefore important in order to development and target primary prevention public health strategies.

A range of studies has described secular trends in physical activity among adolescents. Some studies report increasing levels of physical activity (Booth, Rowlands, Dollman, 2015; Kalman et al. 2015; Sigmundová, El Ansari, Sigmund, & Frömel, 2011) while other studies report that the secular trends are less systematic (Huhman et al., 2012). Other studies have addressed the association between socioeconomic background and physical activity among adolescents, and there is some evidence of a higher level of physical activity with more advantageous socioeconomic background (Borraccino et al. 2009; Ferreira 2006). Studies have also addressed social inequality in physical inactivity, and

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* Corresponding author at: National Research Centre for the Working Environment, Lersø Parkallé 105, 2100 Copenhagen Ø, Denmark.
E-mail address: nifj@si-folkesundhed.dk (N.F. Johnsen).

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these studies suggest that the prevalence of physical inactivity is higher among adolescents with less advantageous socioeconomic background (Henriksen, Rayce, Melkevik, Due, & Holstein, 2015; Singh, Kogan, Siahpush & van Dyck, 2008) although this association is not completely consistent (Stalsberg & Pedersen 2010). This social gradient may change over time, and we have only identified one study that addressed this issue. Inchley, Currie, Todd, Akhtar and Currie (2005) reported a fairly persistent socioeconomic gradient in physical activity among Scottish schoolchildren from 1990 to 2002. It is likely that trends in social inequality in health are country-specific because such trends are related to macro-level economy. There has been a steep increase in income inequality in Denmark over the past twenty years, and since there is a general correlation between the level of income inequality and health problems among adolescents (Rathmann et al., 2015), we expect the social inequality in physical inactivity to increase over time.

This study investigated trends in social inequality in physical inactivity in comparable and representative populations of Danish, 11–15-year-old adolescents from 1991 to 2014. The analyses focused on both absolute and relative social inequalities in physical inactivity.

Methods

Design and study population

This study included data from the Danish part of the international collaborative cross-national Health Behaviour in School-aged Children study (HBSC) at seven points in time (1991, 1994, 1998, 2002, 2006, 2010, 2014) (Roberts et al., 2009; Currie & Alemàn-Diaz, 2015). The overall aim of the HBSC study is to enhance the understanding of young people's health behaviours in their social settings. The study design is a series of cross-sectional surveys of representative samples of three age groups, 11-, 13-, and 15-year-old schoolchildren. In Denmark, data were collected from a random sample of schools, drawn from a complete list of public and private schools. The analyses included data from seven comparable cross-sectional surveys from to 1991 to 2014. The overall response rate (number of participants in the surveys as percentage of schoolchildren enrolled in the participating classes) was 88.2%, N = 31,660. After exclusion of 686 participants with missing information on physical activity the final N was 30,974 (Table 1).

Data collection and measurements

The participants completed the internationally standardised HBSC questionnaire in the classroom. Vigorous physical activity was measured by the item: "OUTSIDE SCHOOL HOURS: How many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?" We dichotomised the responses into "none" vs. "about half an hour" + "about 1 hour" + "about 2 to 3 hours" + "about 4 to 6 hours" + "7 hours or more". Booth, Okely, Chey and Bauman (2001) and Rangul, Holmen, Kurtze, Cuypers and Midthjell (2008) found that this measure has a good reliability and a fair validity in the sense that adolescents who report 0 hours of vigorous physical activity also have low levels of aerobic fitness.

Data on socioeconomic position (SEP) stem from the students' reports of their father's and mother's occupation, coded by the research group into social class I (highest) to V (Christensen et al., 2014). The coding scheme is almost identical to the UK Registrar General's classification into five social classes (Macintyre, McKay, Der & Hiscock, 2003). The coding instruction was consistent across all seven waves of data collection, but it was necessary to change the coding for some occupations with substantial changes in qualification level during the 23 year observation period. Several studies have demonstrated that schoolchildren from the age of 11 are able to report their parents' occupation with a fair validity although often with a high proportion of unclassifiable or missing data (Ensminger, Forrest, Riley, Kang, Green, & Starfield, 2000; Lien, Friedstad, & Klepp, 2001; West, Sweeting, & Speed, 2001; Vereecken & Vandegehuchte, 2003). We added social class VI to include economically inactive parents who receive unemployment benefits, disability pension or other kinds of transfer income. Finally, the category "unclassifiable" was added to describe parents who are working, but for whom the information provided by the child was too vague for categorizing into social class I to V.

Each participating schoolchild was categorised by the highest ranking parent. We categorised social class into high (social class I-II), middle (social class III-IV), low (social class V-VI), and unclassifiable.

Statistical analyses

First, the Cochran-Armitage test for trend (Agresti, 2002) was used to examine trends in physical inactivity over time. This test is based on the regression coefficient for a weighted linear regression of a binomial proportion of a variable (here: prevalence of physical inactivity) on an explanatory variable (here: year of data collection). Second, two measures of social inequality in physical inactivity was applied: 1) Prevalence difference in physical inactivity between high and low social class as an absolute measure of social inequality; 2) odds ratio (OR) for physical inactivity using high social class as reference as a relative measure of social inequality. We conducted logistic regression analyses with sex, age group and year of data collection as control variables. A multivariate logistic regression analysis (Wald's test) was used to test for interaction between social class and year, corresponding to the hypothesis that the difference in social inequality in physical activity

Table 1
Study population by sex, age group, social class, year and physical inactivity.

	Data collection wave							
	1991	1994	1998	2002	2006	2010	2014	Total
Response rate	90.2%	90.9%	88.0%	89.3%	88.8%	86.3%	85.8%	88.2%
N	1860	4046	5205	4824	6269	4922	4534	31,660
N included in this study[a]	1837	3994	5165	4771	6210	4865	4132	30,974
Pct. boys	50.2	49.9	49.6	48.7	49.3	50.1	48.6	49.4
Pct. girls	49.8	50.1	50.4	51.3	50.7	50.0	51.4	50.6
Pct. 11-year-olds	31.7	31.6	33.9	36.4	37.6	37.2	30.5	34.7
Pct. 13-year-olds	34.7	34.7	35.7	33.7	35.6	33.7	35.5	34.8
Pct. 15-year-olds	33.6	33.7	30.4	29.9	26.9	29.1	34.1	30.5
Pct. high social class	25.8	30.3	25.8	22.1	22.3	32.8	38.2	27.8
Pct. middle social class	47.3	44.2	45.9	48.7	40.0	35.9	37.0	42.2
Pct. low social class	18.2	16.7	20.9	18.7	18.4	16.2	14.4	17.8
Pct. unclassifiable	8.8	8.8	7.5	10.5	19.4	15.1	10.5	12.2
Pct. physically inactive	8.1	9.4	10.2	10.3	5.1	7.5	6.6	8.0

[a] Non-respondents of the physical activity question excluded.

was not constant over years. Sex, age group, social class and year were included as independent variables.

SAS version 9.3 (SAS Institute, North Carolina), procedures FREQ and LOGISTIC, was used for the statistical analyses.

Ethical issues

There is no formal agency for approval of questionnaire based surveys in Denmark. Therefore, we asked the school board as the parents' representative, the headmaster, and the students' council in each of the participating schools to approve the study. The participants received oral and written information that participation was voluntary and anonymous. The data file does not comprise data about the identity of the individual participants. The study complies with national standards for data protection and is registered at the Danish Data Protection Agency (J. No. 2013-54-0576).

Results

In the entire study population, 8.0% of the schoolchildren were physically inactive (Table 1). The prevalence of physical inactivity varied by year with a peak in 1998 and 2002 but was generally characterized by an overall decreasing tendency (test for trend, $p < 0.0001$). In the entire study population, the prevalence of physical inactivity was 5.4% in high social class, 7.8% in middle social class, 10.8% in low social class, and 10.9% in the unclassifiable social class, p-value from chi-square test < 0.0001 (data not shown in table).

Fig. 1 shows the prevalence of physical inactivity by year and social class. In each of the social classes there was a generally decreasing proportion of physically inactive across survey year, all p-values < 0.01 (Cochran-Armitage test for trend). The prevalence difference between high and low social classes was 7.8% in 1991 and 5.8%, 5.4%, 5.4%, 3.9%, 4.5% and 6.9% in the subsequent data collection waves. These data suggest that the absolute social inequality in physically inactivity remained fairly stable across this 23-year observation period. The prevalence of physical inactivity in the unclassifiable social class was fairly similar to the middle social class in 1991 and 2014 but otherwise fairly similar to the lower social class (data not shown).

Table 2 shows the relative social inequality in physical inactivity, i.e. the OR (95% CI) for physical inactivity by social class. In the entire study population, the age- and sex-adjusted OR for physical inactivity was 1.48 (1.32–1.65) in the middle social class, 2.18 (1.92–2.47) in the lower social class, and 2.26 (1.97–2.60) in the unclassifiable social class. These estimates did not change much when further adjusted for year of data collection (Table 2, Model 2). The relative social inequality in physical inactivity in each of the data collection fluctuated from one data collection wave to another but remained fairly similar during the entire observation period. There was no evidence of a statistical interaction between social class and year i.e. no statistical significant widening of the difference in social inequality in physical activity over the years ($p = 0.971$).

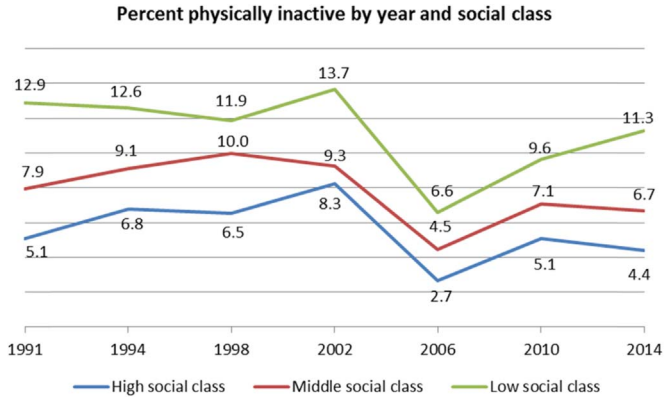

Fig. 1. Percent physically inactive adolescents by year and social class, the Health Behaviour in School-aged Children study (HBSC) 1991–2014.

Discussion

Findings

This is one of the first studies to report on secular changes in the social inequality in physical inactivity among adolescents. There was an overall decreasing trend in the percentage of inactive adolescents, including a substantial drop from 2002 to 2006. There was no change in measurements, data collection or sampling procedures in this period, and the coding or ranking of social classes did not change either. Unfortunately, the study does not include sufficient data to explain this sudden drop.

There was a lower prevalence of physical inactivity with higher family social class, and there was a persistent absolute social inequality across the entire observation period from 1991 to 2014 and a persistent relative social inequality as well. The magnitude of the social class-difference in physical inactivity did not change substantially with time.

The findings correspond with other studies of social inequality in physical inactivity (Stalsberg & Pedersen, 2010). The findings also correspond with the only other study which investigated changes in social inequality in adolescents' physical activity patterns over time (Inchley et al., 2005). Note that the study by Inchley et al. (2005) addressed social inequalities in physical activity, not physical inactivity. They found persistent socio-demographic inequalities in the weekly time spent on vigorous physical activity from 1990 to 2002. The present study does not provide any explanation for the social inequality in physical inactivity, but the finding of a social gradient corresponds with social gradients in many other health compromising behaviours in adolescence (Currie et al., 2012).

Methodological issues

The strength of the study is the comparability of the seven cross-sectional studies, which applied a standard protocol for sampling and measurement and the long observation time. The reference studies on validity of the two main variables, physical inactivity and family social class, suggest that these measurements have acceptable validity. We also believe that the use of social class measured by occupation is a merit of the study, because this variable is a true sociological background variable. Alternatives like wealth and subjective socioeconomic status are less appropriate, because they can be considered as outcome variables of social background rather than true social background indicators. Analyses from the HBSC study often apply the Family Affluence Scale to monitor social inequality in health (Currie et al., 2012). This scale builds on four items about material assets in the family (own bedroom; number of cars, computers and vacations). Because of substantial changes in family affluence over time, this scale may be less comparable over time.

There are limitations as well. First, the measurement of physical inactivity was restricted to lack of vigorous physical activity outside school hours. It may be relevant to also include moderate activity, activity in school time as well as active transport in future studies. The focus on physical inactivity is both a strength and a limitation of the study: a strength because the quantification of inactivity is straightforward because there is no concern about intensity, and in a public health perspective the inactive children and adolescents may constitute a particularly vulnerable high-risk group; a limitation because we cannot generalize the findings of this study to social inequality in physical activity. Second, there may be problems in the comparability of social classes over time. The social class distribution in the population changes over time, mostly because the traditional working classes shrink and the upper middle classes increase in size. These changes in

Table 2
OR (95% CI) for physical inactivity by family social class for each year of data collection adjusted for sex and age group.

Year of data collection	High social class	Middle social class	Low social class	Unclassifiable
1991 (n = 1837)	1	1.60 (0.99–2.59)	2.76 (1.64–4.65)	1.51 (0.73–3.11)
1994 (n = 3994)	1	1.36 (1.03–1.79)	1.98 (1.43–2.72)	2.26 (1.55–3.30)
1998 (n = 5165)	1	1.59 (1.23–2.06)	2.04 (1.53–2.73)	3.62 (2.58–5.06)
2002 (n = 4771)	1	1.13 (0.87–1.47)	1.80 (1.34–2.40)	1.83 (1.30–2.58)
2006 (n = 6210)	1	1.69 (1.16–2.47)	2.60 (1.74–3.88)	3.18 (2.15–4.70)
2010 (n = 4865)	1	1.43 (1.07–1.91)	2.08 (1.50–2.89)	2.53 (1.83–3.49)
2014 (n = 4132)	1	1.55 (1.13–2.13)	2.82 (1.98–4.01)	1.91 (1.24–2.95)
Total (n = 30,974)				
Model 1[a]	1	1.48 (1.32–1.65)	2.18 (1.92–2.47)	2.26 (1.97–2.60)
Model 2[a]	1	1.44 (1.29–1.62)	2.16 (1.90–2.45)	2.48 (2.15–2.85)

[a] Model 1 adjusted for sex and age group, model 2 further adjusted for year of data collection.

the occupational social structure may compromise the validity of the comparison of high and low social classes over time. The 12.6% of the study population with unclassifiable social class is a limitation as well, and there could be many explanations for the missing information (children/adolescents do not know, are unable to remember or explain, or embarrassed). Still, this group has so many similarities with the low social class that it may not influence the general findings of the study. Third, there may be limitations to the generalizability of the findings since the study was conducted in one country only during a period of steep increase in the general income inequality.

Implications

The fact that 8% of adolescents are completely physically inactive calls for new efforts to stimulate physical activity and avoid inactivity. A recent school reform in Denmark which requires one hour of physical activity within school hours every day may have helped and we await further evaluation of this reform. Otherwise, there is a need for interventions to stimulate physical activity, both universal interventions to stimulate physical activity in the entire adolescent population and maybe also interventions targeting lover social classes. From a research point of view there is a need for more studies on the determinants of physical inactivity, and whether these determinants are differentially distributed in different social classes.

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